FIFTEEN YEARS OF MANAGEMENT ON THE CROSSETT FARM FORESTRY FORTIES

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Cover photos: Fourth, tenth, and fourteenth annual harvests from the Crossett good forty.

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Figure 1.--The good forty at Crossett. Although 175,000 board feet of logs, 312 cords of pulpwood, 418 fence posts, and 228 cords of firewood and chemical wood have been removed in the last 15 years, the pine stocking is greater and of better quality than when cutting began.

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As late as 1935 management of the woodlands on the average farm in the South was, for all practical purposes, non-existent. Yet, farm forestry seemed to offer great opportunities. The small landowner usually had as much land in woodland as in row crops. He also often had a stand of trees--of sorts. All he seemed to need was proof that he could manage his forest and make money by doing so.

Shortly after the Crossett Experimental Forest was established in south Arkansas in 1937, it was decided to study the management possibilities of these small tracts of timber. The first objective was to attempt to change previous cutting practice and see if well-managed woodlands containing a mixture of loblolly and shortleaf pine could not be a very profitable part of the average farm. The second objective was to try to put the timber crop on the same annual-return basis as row crops such as corn or cotton. Back in 1937, these were radical propositions, for timber had never brought the farmers much income and the average farm woodland was badly depleted.

What should be done with run-down woodlands? How long would it take to build them up to where good returns could be obtained? Once they had been improved, how much income would they yield?

THE CROSSETT FORTIES

To answer such questions, two "farm forestry forties" were established in 1937. One of these, containing 34 acres, was the most lightly stocked tract on the entire Crossett Experimental Forest. On this, the "poor forty," it was hoped that the annual cuts of forest products would pay current costs of holding the land while the stands were being restocked to good trees.

The second tract was well stocked. It was intended as an example of the returns possible after the run-down stands were built up. It contains 40 acres and is known as the "good forty."

The stands when management began

In 1937 the good forty had, per acre, 1,794 cubic feet (inside bark) of pine in trees over 3.5 inches in diameter at breast height (d. b. h.) and 602 cubic feet of hardwood in trees over 4.5 inches d. b. h. (table 1). Red and white oaks accounted for 42 percent of the hardwood volume, other merchantable hardwoods 26 percent, and unmerchantable hardwood species the other 32 percent.

Table 1.--Stocking per acre on the Crossett forties when management began in 1937

D. b. h. (inches)	Pine						Hardwood					
	Good forty			Poor forty			Good forty			Poor forty		
	Trees	Basal area	Volume	Trees	Basal area	Volume	Trees 1/	Basal area 2/	Volume 2/	Trees 1/	Basal area 2/	Volume 2/
	No.	Sq. ft.	Cu. ft.	No.	Sq. ft.	Cu. ft.	No.	Sq. ft.	Cu. ft.	No.	Sq. ft.	Cu. ft.
4	20.9	1.8	16.7	15.7	1.4	12.6	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
5	19.2	2.6	32.6	14.1	1.9	24.0	11.3	1.5	22.6	23.5	3.2	47.0
6	16.5	3.2	51.2	11.5	2.3	35.6	9.3	1.9	30.7	12.6	2.4	41.6
7	13.6	3.6	70.7	8.1	2.2	42.1	6.8	1.8	32.6	8.3	2.2	39.8
8	12.1	4.2	94.4	5.9	2.1	46.0	5.4	1.8	36.2	3.8	1.3	25.5
9	6.4	2.8	68.5	4.8	2.1	51.4	3.9	1.7	34.7	2.8	1.2	24.9
10	7.0	3.8	98.7	4.3	2.3	60.6	3.5	1.9	39.6	1.9	1.0	21.5
11	6.5	4.3	117.0	3.4	2.2	61.2	2.7	1.8	37.8	1.0	.7	14.0
12	5.5	4.3	123.2	2.9	2.3	65.0	2.4	1.9	40.3	.8	.7	13.5
13	4.6	4.2	124.7	3.0	2.8	81.3	2.3	2.1	45.3	.6	.6	11.8
14	3.8	4.1	122.0	3.3	3.5	105.9	2.6	2.8	59.1	.4	.4	9.0
15	3.6	4.4	134.6	2.5	3.1	93.5	1.3	1.6	33.4	.3	.3	7.7
16	3.4	4.7	146.5	1.9	2.7	81.9	1.1	1.5	31.5	.3	.4	8.6
17	3.0	4.7	147.3	1.9	3.0	93.3	.9	1.4	28.8	.2	.4	6.4
18	2.0	3.5	111.0	.9	1.6	50.0	.6	1.1	21.2	.3	.6	10.5
19	1.4	2.8	87.2	.6	1.2	37.4	.6	1.2	23.3	.1	.2	3.9
20	1.2	2.6	83.6	.2	.4	13.9	.4	.8	17.0	.1	.2	4.3
21	1.0	2.4	77.9	.2	.5	15.6	.4	.9	18.7	.0	...	...
22	.4	1.1	34.6	.1	.3	8.6	.2	.6	10.2	.0	....	...
23	.1	.3	9.5	.0	...	...	.2	.6	11.2	.0	...	...
24	.3	.9	31.0	.0	...	...	.2	.6	12.4	.0	...	...
25	.1	.3	11.1	.0	...	...	.1	.3	6.8	.0	...	...
26	.0	...	....	.0	...	...	.0	..	...	.0	...	...
27	.0	...	...	.0	...	...	.1	.4	8.2	.0	...	...
Total	132.6	66.6	1,794.0	85.3	37.9	979.9	56.3	30.2	601.6	57.0	15.8	290.0

1/ Forty-five percent of the hardwoods on the good forty and 8 percent of those on the poor forty were of unmerchantable species.
2/ Merchantable plus unmerchantable trees.
3/ Four-inch class hardwoods not recorded.

The stand was typical of many unmanaged second-growth pine-hardwood forests. Most of the larger pines had developed under competition in the virgin stand. A large percentage of them had cleaned up to a good height before they had been released by the cutting of the original larger trees. Their quality was generally good, but some were crooked, had heart rot, or were mature. In addition to these virgin residuals, there were some strictly second-growth pines that had grown up with little competition. Most of these were of very low quality. Pine quality was likewise low on three small old-field patches on the compartment.

On the poor forty, hardwoods up to 8 inches in diameter were more numerous than pine. Total pine volume, however, averaged 980 cubic feet per acre as compared to a hardwood volume of 290 cubic feet. Less than half of the ground area of this compartment was being used by trees, and, of the area that was occupied, nearly half was in hardwood or pine of very low quality.

Except for an occasional red or white oak, few of the hardwoods above 12 inches in diameter on either forty contained logs that would produce factory-grade lumber. On both forties, too, the hardwoods that were below sawlog size were of such poor potential quality that they were usually not worth saving.

Type of silviculture employed

Since even trees of the same species do not all grow at the same rate, and since on most areas of 20 acres or more the stands were essentially all-aged or all-diametered (table 1), it was decided to adopt a modified single-tree selection system of silviculture in managing the farm forties. Under such a system, trees could be removed singly or in small groups, and each tree could be cut or left according to its individual merits at the time it was examined. Little difficulty was expected in getting reproduction under this system.

Because large, high-grade sawlogs had a ready market and would net a much greater return per cubic foot of volume than pulpwood, it was decided to produce as many such sawlogs as possible. Long, high-class piling may produce greater returns than sawlogs, but so few small owners know piling specifications or have a market that production of piling did not seem warranted--especially as sales of this material almost always remove the most desirable growing stock from a stand.

The sawlog objective, however, did not rule out the production of pulpwood, chemical wood, firewood, posts, and other subsidiary items, and some of these have been cut nearly every year since 1937. Such products come from those trees and parts of trees that need to be removed but that are not of saw-timber size or grade.

Where cull hardwoods of no economic value interfered with the growth of pines, it was recognized that such hardwoods would have to be removed at some expense. This is consistent with good management, and is a very important part of insuring full stocking.

HOW THE CUTS ARE MADE

Inventory system

In order to minimize error in the estimation of growth, number of trees, or changes in quality with the passage of time, a 100-percent continuous inventory system was adopted for this study. All pines larger than 3.5 inches in d.b.h. and all hardwoods larger than 4.5 inches in d.b.h. are tallied each time an inventory is made. In addition, the merchantable sawlogs in trees larger than 11.5 inches in d.b.h. are tallied and graded.

An annual inventory is not necessary to the success of the study, and so the inventories have been repeated at 5-year intervals only. The first was made in the early summer of 1937, prior to the initiation of the study, and the others in the autumns of 1941, 1946, and 1951.

Computation of allowable cut

The first annual cut was made on the good forty in the fall of 1938 and on the poor forty in the fall of 1939. These were salvage and improvement cuts to remove merchantable pines and hardwoods that were of very poor form or had rot in them. No allowable cut was determined on either forty this first year, but neither were all poor trees removed. The next 4 annual cuts were based on an estimate of the average yearly growth on each forty. Subsequent cuts were based on the estimated average yearly growth on each forty, as revealed by the 5-year inventories.

Since the good forty was reasonably well stocked, it was decided to remove each year a volume in cubic feet approximately equal to the total cubic-foot growth of pine larger than 3.5 inches in d.b.h. This plan has been followed for each of the last 14 years. On the poor forty

the annual cuts have removed only about half of the total yearly pine cubic-foot growth in trees larger than 3.5 inches in d.b.h. This plan has been followed in order to build up the growing stock to a desirable level.

At the end of each 5-year period, a change is made to bring the annual allowable cut for each forty in line with the growth determined from the inventory.

Not all of the area of each forty contributes to each cut. Every year the whole of each forty is inspected and the portion in greatest need of attention is selected for the annual harvest. Usually the cut is taken from about 10 acres, but sometimes 20 acres are covered, and sometimes only 5. This flexible system also makes it possible to cut annually, from any place on the forty, trees that have been damaged by lightning, insects, or redheart.

Type of trees removed in cutting

The principle of always removing the poorest and most mature trees and saving the best ones has been followed in all marking and cutting. However, not all crooked, rough, or non-perfect trees have yet been cut. Many trees with crooked tops or a sweep in the bole have two or more clear logs, are growing 3 to 4 inches in diameter in ten years, and have crowns so high from the ground that the understory can develop for many more years without serious interference.

Nor has perfect spacing of the growing-stock trees been attained in the first 15 years. The distribution of stems is constantly improving, but perfection probably will never be had. Good immature stems are never sacrificed to get good distribution, and immature trees of a given diameter class are not cut just because there may appear to be a temporary oversupply of this size.

All in all, the aim has been to improve quality, spacing, and diameter distribution gradually, without appreciably diminishing potential earnings, and to make the best use of the potential growth and possible earnings of each tree before cutting it. A first step in carrying out this aim was to deal with the hardwood problem.

THE HARDWOOD PROBLEM

As has been noted, the hardwoods on the good forty in 1937 were of poor quality. It was thought, however, that good stems could be developed. Since this was a farm woodland, it seemed necessary to carry at least enough volume of the better hardwood species of good form to provide the equivalent of an annual cut of firewood.

By 1943 it was apparent that the hardwoods on these upland sites would grow very slowly even under management and could not begin to compete with pine from the standpoint of dollar returns per unit of growing space. Beginning in 1944, therefore, the annual allowable cut was based on pine growth only. The volume of any hardwoods that could or should be removed was additional.

By 1947 the farmers who were likely to be interested in timber management on pine sites were no longer using wood for heating and cooking. Most of them had switched to fuel oil or gas. It was therefore decided to remove the remainder of the merchantable hardwoods during the next four years. This was done, the final cut of hardwood products on the good forty being made in the fall of 1950.

The poor forty had so many fire-scarred, rough, and low-crowned hardwoods in 1937 that all those with any merchantable products were removed as fast as the pine could take over the growing space that the hardwoods were occupying. The last merchantable hardwoods were cut in 1945.

Cutting the merchantable hardwoods from the forties, of course, did not remove all of the hardwood trees. Stems of all sizes from 20-inch cull hickories and elms down to 1-inch sprouts of many species were still occupying considerable space and suppressing pine reproduction. In order to reduce this competition, a general timber stand improvement job was undertaken in the spring of 1951. In this, all remaining hardwoods larger than 3.5 inches in diameter were girdled, and smaller hardwood sprouts were cut wherever they were overtopping any needed pine reproduction.

Cost of timber stand improvement

This job required a total of 2.6 man-hours per acre on the good forty and 2.4 man-hours for the poor forty.

A farmer would probably do such stand improvement for himself. If he did, his cash outlay for the work would not be over 2 cents per acre

per year over the first 15-year period. If the work were done by hired labor at $0.80 per hour, the labor cost would be $2.08 per acre on the good forty and $1.92 per acre on the poor forty. The cost per acre per year for the 15 years has, therefore, averaged $0.14 for the good and $0.13 for the poor forty. Over a period of years an allowance of 0.2 man-hour, or about $0.15 per acre per year, is probably ample for timber stand improvement on most farm woodlands where pine or reasonably good hardwood seedlings are present or can be obtained by natural reproduction.

This has been the first non-revenue cutting on the forties. It undoubtedly will not be the last. However, as will be shown later, pine seedlings now have enough growing room so that the next improvement cut is several years in the future (fig. 2).

HARVESTS AND RETURNS

Products removed

Fourteen annual harvest cuts have been made from the good forty during the 1938-51 period. These have totaled approximately 174,500 board feet, Doyle scale (205,600 board feet, International 1/4-inch scale), of logs. The cuts also yielded 312 cords of pulpwood, 228 cords of chemical wood and firewood, and 418 white oak and post oak fence posts (table 2).

The average yearly harvest has been 12,470 board feet, Doyle scale (14,690 board feet International), of sawlogs; 22.3 cords of pulpwood; 16.3 cords of firewood and chemical wood; and 29.9 fence posts. Per acre, the various cuts have removed 4,360 board feet, Doyle scale (5,140 board feet International), of logs; 7.8 cords of pulpwood; 5.7 cords of firewood and chemical wood; and 10.4 fence posts.

On the poor forty the 13 annual harvests have totaled approximately 57,500 board feet, Doyle scale (67,700 board feet International), of logs; 153 cords of pulpwood; 158 cords of firewood and chemical wood; and 121 fence posts (table 3).

The average cut per year for the 13 years has been 4,420 board feet, Doyle scale (5,210 board feet International), of logs; 11.8 cords of pulpwood; 12.2 cords of firewood and chemical wood; and 9.3 fence posts. Per acre, these cuts have removed a total of 1,690 board feet, Doyle scale (1,990 board feet International), of logs; 4.5 cords of pulpwood; 4.7 cords of firewood and chemical wood; and 3.6 posts.

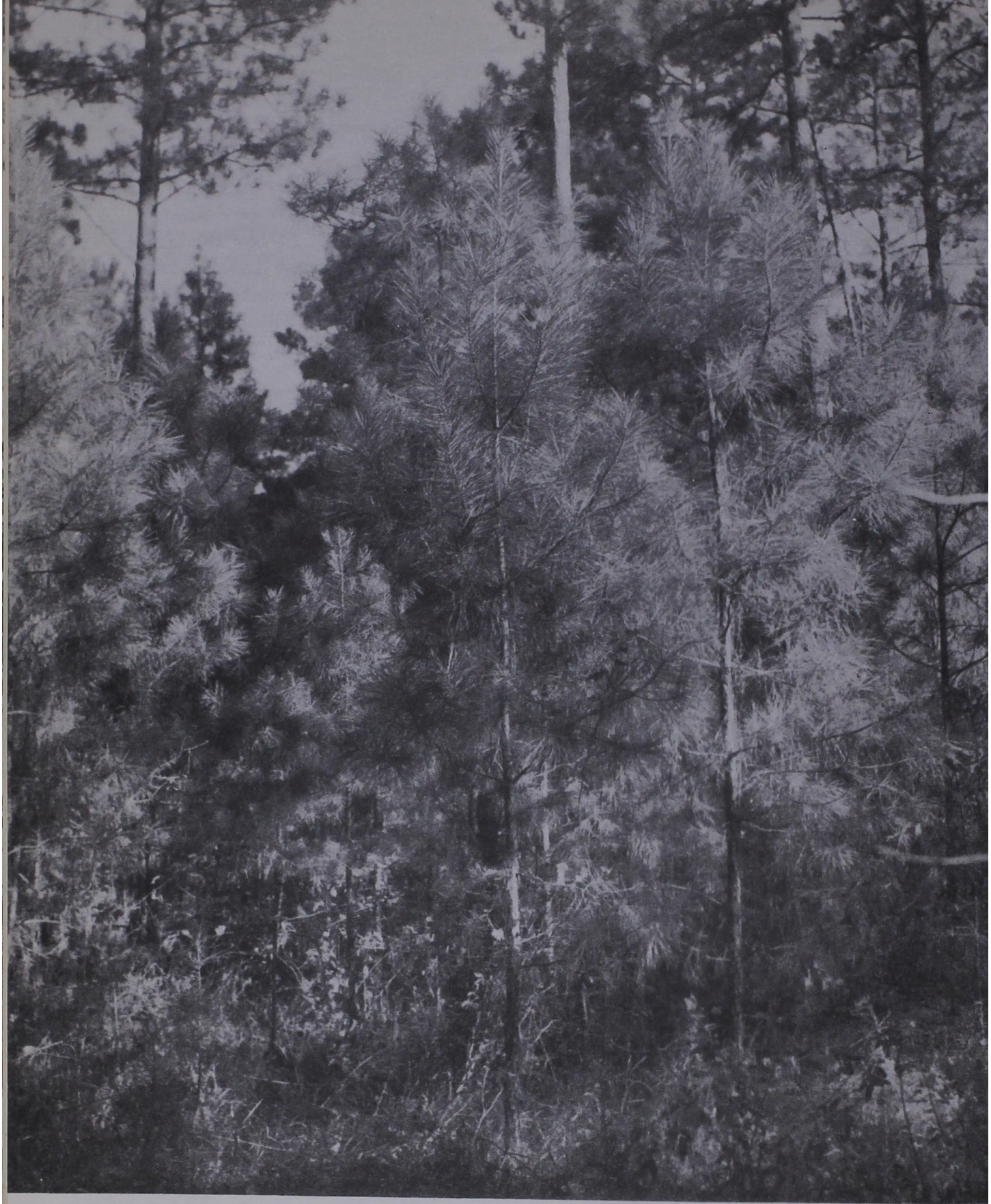

Figure 2. --Good fire protection and the removal of low-quality hardwoods have enabled fast-growing pines to occupy practically all of the growing space on both forties.

Table 2. --Volume and value of products from the good farm forestry forty (Compartment 51--40 acres)

Year	Logs: Volume	Logs: Stumpage value: Per M Doyle	Logs: Stumpage value: Total	Logs: Mill value: Per M Doyle	Logs: Mill value: Total	Pulpwood: Volume	Pulpwood: Value per cord: Stumpage	Pulpwood: Value per cord: Mill	Pulpwood: Total value: Stumpage	Pulpwood: Total value: Mill	Chemical wood and firewood: Volume	Chemical wood and firewood: Value per cord: Stumpage	Chemical wood and firewood: Value per cord: Mill	Chemical wood and firewood: Total value: Stumpage	Chemical wood and firewood: Total value: Mill	Value of all products: Stumpage 1/	Value of all products: Roadside	Value of all products: Mill 2/
	Bd. ft., Doyle	Dollars		Dollars		Standard cords	Dollars				Standard cords	Dollars				Dollars		
1937						3.58	1.00	6.00	3.58	21.48						3.58	12.53	21.48
1938						60.90	1.00	6.00	60.90	365.40						60.90	213.15	365.40
1939	5,122	8.00	40.98	15.75	80.67	18.04	1.00	6.00	18.04	108.24	62.60	0.50	8.00	31.30	500.80	92.42	394.22	696.01
1940	15,426	8.00	123.41	15.75	242.96	12.25	1.00	6.00	12.25	73.50	34.91	.50	8.00	17.46	279.28	154.62	377.43	600.24
1941	19,519	8.00	156.15	15.75	307.42	43.49	1.00	6.00	43.49	260.94	6.00	.50	8.00	3.00	48.00	204.29	412.80	621.31
1942	16,723	8.00	133.78	15.75	263.39	42.09	1.00	6.00	42.09	252.54	11.33	.50	8.00	5.66	90.64	183.28	397.55	611.82
1943	14,938	8.00	119.50	15.75	235.27	35.19	1.00	6.00	35.19	211.14	9.50	.50	8.00	4.75	76.00	161.19	344.43	527.66
1944	13,904	13.17	183.11	23.67	329.11	18.32	1.50	10.00	27.48	183.20	10.26	.75	8.78	7.70	90.06	220.04	413.83	607.62
1945	13,144	12.36	162.47	22.86	300.49	15.33	1.50	10.00	23.00	153.30	11.97	.75	12.00	8.98	143.64	196.55	400.14	603.73
1946	11,760	14.69	172.70	27.19	319.70	24.24	2.00	10.50	48.48	254.52	6.58	.75	15.00	4.94	98.70	227.92	453.12	678.32
1947	11,661	17.73	206.73	31.23	364.16	7.81	2.00	10.75	15.62	83.96	17.43	.75	12.00	13.07	209.16	236.67	448.85	661.03
1948	13,864	24.74	343.06	39.74	551.02	5.33	2.25	11.60	11.99	61.83	23.72	.75	12.00	17.79	284.64	374.39	638.27	902.14
1949	12,631	24.12	304.72	38.12	481.54	3.44	2.00	11.35	6.88	39.04	14.21	.50	11.75	7.10	166.97	320.75	507.23	693.70
1950	12,099	32.58	394.14	47.58	575.63	4.04	2.25	12.25	9.09	49.49	19.94	.50	11.15	9.97	222.33	414.85	633.63	852.40
1951	13,741	39.08	537.06	55.08	756.92	17.75	3.00	13.50	53.25	239.62	.00	...	...	...	...	590.31	793.43	996.54
Total	3/174,532		2,877.81		4,808.28	311.80			411.33	2,358.20	228.45			131.72	2,210.22	3,441.76	6,440.61	9,439.40
Average		16.49		27.55			1.32	7.56				.58	9.67					

1/ Includes stumpage value of $20.90 for 418 posts produced 1939-50. 2/ Includes market value of $62.70 for 418 posts produced 1939-50. 3/ Equal to 205,600 board feet, Int. 1/4-inch scale.

Table 3. --Volume and value of products from the poor farm forestry forty (Compartment 56--34 acres)

Year	Logs: Volume	Logs: Stumpage value: Per M Doyle	Logs: Stumpage value: Total	Logs: Mill value: Per M Doyle	Logs: Mill value: Total	Pulpwood: Volume	Pulpwood: Value per cord: Stumpage	Pulpwood: Value per cord: Mill	Pulpwood: Total value: Stumpage	Pulpwood: Total value: Mill	Chemical wood and firewood: Volume	Chemical wood and firewood: Value per cord: Stumpage	Chemical wood and firewood: Value per cord: Mill	Chemical wood and firewood: Total value: Stumpage	Chemical wood and firewood: Total value: Mill	Value of all products: Stumpage	Value of all products: Roadside	Value of all products: Mill
	Bd. ft., Doyle	Dollars		Dollars		Standard cords	Dollars				Standard cords	Dollars				Dollars		
1939	0	...	...	...	...	20.25	0.667	3.50	13.50	70.88	74.46	0.46	3.70	34.25	275.50	1/51.38	203.12	2/354.85
1940	2,996	6.10	18.27	10.60	31.75	10.22	.667	3.75	6.82	38.32	3.40	.48	4.12	1.63	14.01	26.72	55.40	84.08
1941	2,748	8.83	24.26	14.83	40.75	10.84	1.00	5.15	10.84	55.83	.00	...	...	...	...	35.10	65.84	96.58
1942	5,314	9.39	49.90	16.39	87.10	4.45	1.00	6.00	4.45	26.70	9.77	.75	5.50	7.33	53.74	61.68	114.61	167.54
1943	5,134	12.02	61.71	21.02	107.92	21.48	1.00	7.75	21.48	166.47	.00	...	...	...	...	83.19	178.79	274.39
1944	0	...	...	...	...	60.00	1.50	10.00	90.00	600.00	31.95	.70	8.77	22.36	280.20	112.36	496.28	880.20
1945	0	...	...	...	...	.36	1.50	10.00	.54	3.60	38.84	.75	11.98	29.13	465.30	29.67	249.28	468.90
1946	3,790	16.37	62.05	28.86	109.38	2.67	2.00	10.50	5.34	28.04	.00	...	...	...	...	67.39	102.40	137.42
1947	4,521	17.08	77.23	30.58	138.26	5.16	2.00	10.75	10.32	55.47	.00	...	...	...	...	87.55	140.64	193.73
1948	7,533	24.14	181.88	39.14	294.87	6.73	2.25	11.60	15.14	78.07	.00	...	...	...	...	197.02	284.98	372.94
1949	10,309	26.38	271.98	40.38	416.32	.00	...	...	...	...	.00	...	...	...	...	271.98	344.15	416.32
1950	6,502	42.58	276.84	57.58	374.37	6.02	2.25	12.25	13.54	73.74	.00	...	...	...	...	290.38	369.24	448.11
1951	8,627	39.70	342.46	55.70	480.50	4.70	3.00	13.50	14.10	63.45	.00	...	...	...	...	356.56	450.26	543.95
Total	3/57,474		1,366.58		2,081.22	152.88			206.07	1,260.57	158.42			94.70	1,088.75	1,670.98	3,054.99	4,439.01
Average		23.78		36.21			1.35	8.25				.60	6.87					

1/ Includes stumpage value of $3.63 for 121 posts produced in 1939. 2/ Includes market value of $8.47 for 121 posts produced in 1939. 3/ Equal to 67,700 board feet, Int. 1/4-inch scale.

Sawlogs have produced the greatest return for a given volume of wood. Consequently, every tree that would make lumber was cut into one or more logs. Hardwood sawlogs made up only 9 percent of the total cut on the good forty and only one percent of the cut on the poor forty (table 4). These figures help to substantiate the statement that the hardwood was very low grade on both compartments.

Table 4. --Proportions of products in total fifteen-year cut from the farm forties

Product	Good forty			Poor forty		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	- - - - - - - - - - - - Percent - - - - - - - - - - - -					
Sawlogs	30	9	39	30	1	31
Pulpwood	30	8	38	36	(1/)	36
Firewood and chemical wood	...	23	23	...	33	33
Posts	...	(1/)	(1/)	...	(1/)	(1/)
Total	60	40	100	66	34	100

Basis: Total cubic volume, inside bark, of all products removed.
1/ Negligible.

Of the total volume of products, only pine sawlogs--which made up 30 percent of the total cut from each forty--came from what might be considered permanent growing stock.

Returns from annual harvests

Good forty. --At the stumpage prices that prevailed locally each year in which the harvesting was done, the 174,500 board feet (Doyle scale) of sawlogs yielded $2,878 (table 2). The 312 cords of pulpwood returned $411. The 228 cords of chemical wood and firewood were worth $132, and 418 posts $21. Thus, the total stumpage value produced to date has been $3,442, or $86 per acre--$6.15 per acre per year. Had present-day prices ($40 per thousand board feet, Doyle scale, for logs; $3.00 per standard cord for pulpwood; $0.50 per cord for chemical wood and firewood; and $0.10 each for posts) prevailed throughout the 14 years, total stumpage returns would have equaled $8,073, or $202 per acre--$14.42 per acre per year.

The value of the products delivered to the mill, market, or railroad siding totaled $9,439 for the 14 crops. This amounted to $236 per acre, or $16.86 per acre per year. At present-day values, the returns would have been $16,808, or $420 per acre--$30 per acre per year.

Some farmers do not have the equipment to haul logs and pulpwood. They do, however, usually have the means to cut and bunch the products alongside a road. It is estimated that the roadside value of the products harvested to date has been $6,441. This is approximately $161 per acre, or $11.50 per acre per year. Had present-day prices and costs prevailed throughout the study, the roadside value of the products to date would have been approximately $12,441, or $311 per acre--$22 per acre per year.

Poor forty. --It has been noted that, in order to build up the growing stock, the cuts on the poor forty have been held to only half of the estimated growth each year. Returns, however, have been far above expectations. The 13 annual cuts have produced 57,474 board feet (Doyle scale) of logs, worth $1,367 at prices prevailing in the year the harvesting was done. The 153 cords of pulpwood were worth $206. Chemical wood and firewood equivalent to 158 standard cords was worth $95, and 121 fence posts had a stumpage value of $4 (table 3).

Thus, the total stumpage return to date has been $1,671, or $49.15 per acre--$3.78 per acre per year for the 13 cuts. Since out-of-pocket costs, including timber stand improvement and taxes, would have averaged less than $0.35 per acre per year, the average owner would have netted better than $2.90 per acre per year for the 15 years of management.

If present-day stumpage prices had prevailed over the life of the study, the total stumpage return would have been $2,849, or $83.79 per acre--$6.45 per acre per year.

At the prices that were current during the year when harvesting was done, the roadside value of the products from the poor forty to date has been approximately $3,055, or $90 per acre--$6.91 per acre per year.

At present-day stumpage prices and costs, it is estimated that roadside value would have been $5,151, and total value delivered to mill or market $7,452. Thus, the roadside value per acre per year would have been $11.65, and the market value $16.86 for the 13 cuts made to date.

The yearly total average mill or market value of the products from the good forty has been nearly $700. The yearly cuts from the 34-acre poor forty have averaged $341. Under present-day prices these values would have been $1,200 per year for the good forty and $573 for the poor forty. Such returns are equal to the total returns that many farmers in the upland areas make from row-crop farming.

Cost of producing the forest crop

Forest management also has its costs. Taxes on farm woodland in south Arkansas and north Louisiana vary from $0.10 to $0.20 per acre per year. The average is about $0.15. Woodlands should be listed with the State fire protection agencies--at a cost of $0.02 per acre per year. The owner undoubtedly would also spend considerable time in watching for or extinguishing fires that threaten his property, but only rarely would this entail additional out-of-pocket costs.

Marking trees for cutting, supervising the logging, and scaling the products have required less than 2 man-days per year per 40 acres. However, since the average owner would have less experience than the trained personnel used on the Crossett forties, a full two man-days per forty per year has been allowed. On this basis, the cash outlay for these jobs would average about $3 per forty per year.

The total out-of-pocket costs and the labor required annually per acre for either of the forties are estimated as follows:

	Dollars	Man-hours
Taxes	0.15	...
Fire protection	.02	0.40
Timber stand improvement	.02	.20
Timber marketing	.08	.20
Scaling and supervision	...	.20
Total	.27	1.00

The total 15-year costs for the good forty would be $162 plus 600 man-hours of labor. The 15-year costs for the 34 acres in the poor forty would be $137.70 plus 510 man-hours of labor.

Assuming that all products were sold as stumpage in the standing tree, the net return for the good forty would be $3,441.76 minus $162.00, or $3,279.76. This is equal to $5.47 for each of the 600 man-hours expended in producing the crop; it of course includes a return on the investment as well as a return for labor.

The net stumpage return for 15 years of management of the poor forty is $1,670.98 minus $137.70 or $1,533.28, an average return of $3.01 per man-hour of labor, again including interest on the investment.

Hourly returns for harvesting the forest crop

The foregoing are stumpage returns. If the owner harvested his timber himself he would be paid for his labor as well as for his wood. Tables 5 and 6 record the man-hours expended in producing the annual harvests from both forties. Table 7 gives the average man-hour requirements for producing a unit of each product.

Table 5.--Labor requirements for harvesting the good farm forestry forty (Compartment 51--40 acres)

Year	Logs			Pulpwood			Chemical wood and firewood			Total labor requirements 1/	
	Volume produced	Labor		Volume produced	Labor		Volume produced	Labor		Labor	
		To roadside	To mill		To roadside	To mill		To roadside	To mill	To roadside	To mill
	Bd. ft., Doyle	-- Man-hours --		Standard cords	-- Man-hours --		Standard cords	-- Man-hours --		-- Man-hours --	
1937				3.58	21.48	36.16				21.48	36.16
1938				60.90	365.40	615.09				365.40	615.09
1939	5,122	24.38	30.73	18.04	108.24	182.20	62.60	582.18	964.04	721.10	1,185.37
1940	15,426	73.43	92.56	12.25	73.50	123.73	34.91	324.66	537.61	476.09	759.90
1941	19,519	92.91	117.11	43.49	260.94	439.25	6.00	55.80	92.40	414.60	655.36
1942	16,723	79.60	100.34	42.09	252.54	425.11	11.33	105.37	174.48	442.76	706.93
1943	14,938	71.10	89.63	35.19	211.14	355.42	9.50	88.35	146.30	375.84	598.35
1944	13,904	66.18	83.42	18.32	109.92	185.03	10.26	95.42	158.00	276.77	433.45
1945	13,144	62.57	78.86	15.33	91.98	154.83	11.97	111.32	184.34	272.17	426.43
1946	11,760	55.98	70.56	24.24	145.44	244.82	6.58	61.19	101.33	268.01	423.91
1947	11,661	55.51	69.97	7.81	46.86	78.88	17.43	162.10	268.42	268.22	422.27
1948	13,864	65.99	83.18	5.33	31.98	53.83	23.72	220.60	365.29	323.22	508.50
1949	12,631	60.12	75.79	3.44	20.64	34.74	14.21	132.15	218.83	219.06	337.56
1950	12,099	57.59	72.59	4.04	24.24	40.80	19.94	185.44	307.08	272.22	427.07
1951	13,741	65.41	82.45	17.75	106.50	179.28	.00	...	...	171.91	261.73
Total	174,532	830.77	1,047.19	311.80	1,870.80	3,149.17	228.45	2,124.58	3,518.12	4,888.85	7,798.08

1/ Totals include values for 418 posts produced in the 1939-50 period: man-hours to roadside 62.70; to market 83.60.

Table 6.--Labor requirements for harvesting the poor farm forestry forty (Compartment 56--34 acres)

Year	Logs			Pulpwood			Chemical wood and firewood			Total labor requirements	
	Volume produced	Labor		Volume produced	Labor		Volume produced	Labor		Labor	
		To roadside	To mill		To roadside	To mill		To roadside	To mill	To roadside	To mill
	Bd. ft., Doyle	-- Man-hours --		Standard cords	-- Man-hours --		Standard cords	-- Man-hours --		-- Man-hours --	
1939				20.25	121.50	204.52	74.46	692.48	1,146.68	1/832.13	1/1,375.40
1940	2,996	14.26	17.98	10.22	61.32	103.22	3.40	31.62	52.36	107.20	173.56
1941	2,748	13.08	16.49	10.84	65.04	109.48	.00	...	...	78.12	125.97
1942	5,314	25.29	31.88	4.45	26.70	44.94	9.77	90.86	150.46	142.85	227.28
1943	5,134	24.44	30.80	21.48	128.88	216.96	.00	...	...	153.32	247.75
1944	0	...	...	60.00	360.00	606.00	31.95	297.14	492.03	657.14	1,098.03
1945	0	...		.36	2.16	3.64	38.84	361.21	598.14	363.37	601.78
1946	3,790	18.04	22.74	2.67	16.02	26.97	.00	...	...	34.06	49.71
1947	4,521	21.52	27.13	5.16	30.96	52.12	.00	...	...	52.48	79.25
1948	7,533	35.86	45.20	6.73	40.38	67.97	.00	...	...	76.24	113.17
1949	10,309	49.07	61.85	.00	...	...	.00	...	...	49.07	61.85
1950	6,502	30.95	39.01	6.02	36.12	60.80	.00	...	...	67.07	99.81
1951	8,627	41.06	51.76	4.70	28.20	47.47	.00	...	...	69.26	99.23
Total	57,474	273.57	344.84	152.88	917.28	1,544.08	158.42	1,473.31	2,439.67	2,682.31	4,352.79

1/ Includes 121 posts produced in 1939: man-hours to roadside 18.15; to market 24.20.

Table 7. --Average labor requirements per product unit

Product	To roadside	To mill or market
	- Man-hours -	
Logs, per MBM	4.76	6.0
Pulpwood, per cord	6.00	10.1
Chemical wood and firewood, per cord	9.30	15.4
Posts, each	.15	.2

The 14 annual cuts on the good forty have produced nearly 8,000 man-hours of labor opportunity for harvesting products and delivering them to mill or market. This is equal to 557 man-hours, approximately 3-1/2 man-months, per year. The labor opportunity for delivery of the products to roadside has been nearly 5,000 man-hours--an average of 349 man-hours, about 2 man-months, per year.

When total out-of-pocket costs of producing the forest crop are deducted from total stumpage returns for the 1937-51 period, the net is $3,279.76. Deducting the same costs from mill values leaves $9,277.40. The difference between the two figures, $5,997.64, is the return for logging and for hauling the products to mill or market. This divided by 7,798 man-hours gives a return equal to $0.77 per man-hour for labor and use of equipment. The hourly return has varied from $0.25 per hour in the early years of the study, when prices and wages were low, to $1.11 per hour during 1946-51.

The return per hour for delivery of forest products, f. o. b. roadside, has been similarly computed. The average for the 14-year period is $0.61 per hour of labor, and the return for 1946-51 $0.86 per hour.

Since 1939 the poor forty has produced approximately 2,700 man-hours of labor opportunity for delivery of the forest products to roadside, and 4,350 man-hours for delivery to market. This is equal to 42 man-days per year for delivering the products to market. The return for delivering the products to roadside has averaged $0.52 and to the mill or market $0.64 per hour. Over the last 5-year period, the return has averaged $1.23 per hour for delivery of products to roadside and $1.70 per hour for delivery to mill or market. Returns per hour of labor have been greater on the poor than on the good forty for the last 5 years because pine sawlogs, which require the least labor per unit volume of any product, have made up a larger proportion of the total production on the poor forty than on the good.

THE STANDS AFTER 15 YEARS OF MANAGEMENT

Changes in stand structure and volume

Good forty. --The 14 annual cuts on the good forty have removed 51.5 pines per acre from the original stand of 132.6 pines per acre that were larger than 3.5 inches in d. b. h. (table 8). These cuts have also removed an average of 48.7 per acre of the original 56.3 hardwoods larger than 4.5 inches in d. b. h. The remaining hardwoods have been girdled. On the face of it, it looks as if sooner or later the area would run out of pine trees. This subject needs some consideration.

First, it must be remembered that until management started in 1937 the stand had never had any attention other than the cut of virgin timber to a 12-inch diameter in 1915, and fire protection starting in 1933. As a result, many of the smaller pines were badly suppressed or very crooked. A great many of these were removed in thinnings and salvage cuttings in the early years. Two ice storms took some more, only part of which could be salvaged. All together, salvage and thinning accounted for 38.3 out of the total of 51.5 pine trees per acre that were removed during the 15-year period. The harvest cutting of the more valuable sawlog-size trees removed only 13.2 trees per acre--less than one tree per acre per year! Of equal importance, the number of trees that were more than 12 inches in diameter not only increased from 30.4 to 36.1 per acre during the period but the average size of these trees increased from 15.6 to 16.5 inches in d. b. h. (fig. 3).

From this it is reasonable to conclude that the number of trees cut each year in the second 15-year period will be considerably less than the number cut per year so far. However, it is also apparent that far fewer trees will have to be cut each year to get a given volume, and certainly to get a given return per acre.

The good forty now has 82 pines per acre that are 4 inches in diameter and larger (tables 9 and 10). If most of these grow into the 12-inch and larger diameter classes, as they are expected to do, they will yield annual cuts for about 80 years in the future if one sawlog-size tree per acre per year is removed. If two trees per acre are cut each year, the present stand 4 inches in d. b. h. and larger will support about 40 annual cuts without any new trees growing into merchantable sizes. The area is not likely to run out of pines at any time soon.

Nevertheless, a few more trees in the 4- to 11-inch diameter classes would be welcome. Fortunately, this is not a critical shortcoming, and it will not last much longer. It arose largely because the

Table 8. --Pine cut per acre by diameter classes, 1937-51 [1/]

D. b. h. (inches)	Good forty			Poor forty		
	Trees cut	Basal area	Volume	Trees cut	Basal area	Volume
	No.	Sq. ft.	Cu. ft.	No.	Sq. ft.	Cu. ft.
4	2.3	0.2	1.8	1.8	0.2	1.4
5	8.6	1.2	14.6	3.9	.5	6.6
6	8.4	1.6	26.0	3.5	.7	10.8
7	6.7	1.8	34.8	2.6	.7	13.5
8	4.8	1.7	37.4	1.9	.7	14.8
9	3.2	1.4	34.2	1.9	.8	20.3
10	2.4	1.3	33.8	2.2	1.2	31.0
11	1.9	1.2	34.2	2.0	1.3	36.0
12	1.8	1.4	40.3	1.8	1.4	40.3
13	1.6	1.5	43.4	1.4	1.3	37.9
14	1.2	1.3	38.5	1.1	1.2	35.3
15	1.1	1.3	41.1	1.5	1.8	56.1
16	.8	1.1	34.5	1.6	2.2	69.0
17	1.2	1.9	58.9	.9	1.4	44.2
18	1.0	1.8	55.5	1.4	2.5	77.7
19	.8	1.6	49.8	1.0	2.0	62.3
20	.8	1.7	55.8	.6	1.3	41.8
21	.8	1.9	62.3	.6	1.4	46.7
22	.9	2.4	77.8	.4	1.1	34.6
23	.5	1.4	47.4	.1	.3	9.5
24	.3	.9	31.0	.1	.3	10.3
25	.2	.7	22.2	.0	...	...
26	.1	.4	11.9	.0	...	...
27	.1	.4	12.7	.0	...	...
Total	51.5	32.1	899.9	32.3	24.3	700.1

1/ All merchantable hardwoods have either been cut or girdled. See table 1 for approximate number and volume by diameter classes.

Table 9. --Pine stocking per acre on the farm forestry forties, 1951

D. b. h. (inches)	Good forty			Poor forty		
	Trees	Basal area	Volume	Trees	Basal area	Volume
	No.	Sq. ft.	Cu. ft.	No.	Sq. ft.	Cu. ft.
4	9.8	0.9	7.8	30.9	2.7	24.7
5	8.7	1.2	14.8	22.2	3.0	37.7
6	5.5	1.1	17.0	14.9	2.9	46.2
7	4.4	1.2	22.9	11.9	3.2	61.9
8	4.4	1.5	34.3	6.7	2.3	52.3
9	4.6	2.0	49.2	6.1	2.7	65.3
10	4.4	2.4	62.0	6.5	3.5	91.6
11	4.6	3.0	82.8	6.0	4.0	108.0
12	4.7	3.7	105.3	5.6	4.4	125.4
13	5.1	4.7	138.2	4.0	3.7	108.4
14	4.4	4.7	141.2	2.8	3.0	89.9
15	3.4	4.2	127.2	2.3	2.8	86.0
16	3.5	4.9	150.8	2.1	2.9	90.5
17	3.0	4.7	147.3	2.2	3.5	108.0
18	2.8	4.9	155.4	1.1	1.9	61.0
19	3.1	6.1	193.1	1.7	3.3	105.9
20	1.8	3.9	125.5	.9	2.0	62.7
21	1.8	4.3	140.2	.8	1.9	62.3
22	1.0	2.6	86.4	.5	1.3	43.2
23	.7	2.0	66.4	.3	.9	28.5
24	.4	1.3	41.3	.3	.9	31.0
25	.2	.7	22.2	.1	.3	11.1
26	.1	.4	11.9	.1	.4	11.9
27	(1/)	(1/)	(1/)	.0	...	...
28	.1	.4	13.5	.0	...	...
Total	82.5	66.8	1,956.7	130.0	57.5	1,513.5

1/ Negligible.

Table 10.--Pine growing stock per acre, by inventory periods

Item	Good forty				Poor forty			
	1937	1941	1946	1951	1937	1941	1946	1951
	Number				Number			
Trees:								
3.5 to 11.5 inches	102	91	51	46	68	71	68	105
11.5 inches +	30	31	31	36	17	21	19	25
Total	132	122	82	82	85	92	87	130
	Square feet				Square feet			
Basal area:								
3.5 to 11.5 inches	26	25	16	13	17	19	18	24
11.5 inches +	40	43	44	54	21	27	26	33
Total	66	68	60	67	38	46	44	57
	Cubic feet				Cubic feet			
Total volume:								
3.5 to 11.5 inches	550	524	354	291	334	394	373	488
11.5 inches +	1,244	1,339	1,378	1,666	646	819	808	1,026
Total	1,794	1,863	1,732	1,957	980	1,213	1,181	1,514
	Board feet				Board feet			
Saw-timber volume (Doyle):								
11.5 to 19.5 inches	4,027	4,413	4,791	5,571	2,191	2,840	3,057	3,399
19.5 inches +	1,047	1,353	1,663	2,724	150	295	644	1,184
Total	5,074	5,766	6,454	8,295	2,341	3,135	3,701	4,583
Saw-timber volume (Int. 1/4):								
11.5 to 19.5 inches	4,744	5,199	5,644	6,563	2,581	3,346	3,602	4,004
19.5 inches +	1,234	1,593	1,959	3,209	176	347	758	1,395
Total	5,978	6,792	7,603	9,772	2,757	3,693	4,360	5,399

hardwoods that occupied much of the area over the first 10 years kept out considerable pine reproduction. Some pine, however, did come in under the hardwoods, and an abundance of seedlings has shown up in the last several years.

Where these young pines occur in any kind of opening they are growing rapidly. Some that are now just under 3.5 inches in d. b. h. will soon overtake in diameter some of the older and larger trees that have been present for some time. Over the next few years, therefore, there will be a big surge of reproduction into the 4- to 8-inch size classes. These young trees will soon fill the diameter gaps in the present stand and will supply plenty of trees to support the present rate of cutting. In fact, they promise a big increase in future pulpwood production.

Poor forty.--The 13 cuts on the poor forty have removed 32 of the original 85 pine trees per acre (table 8). In spite of this relatively heavy cut, the stand in 1951 had 130 pine trees per acre (tables 9 and 10) that were 4 inches in d. b. h. or larger--half again as many as when

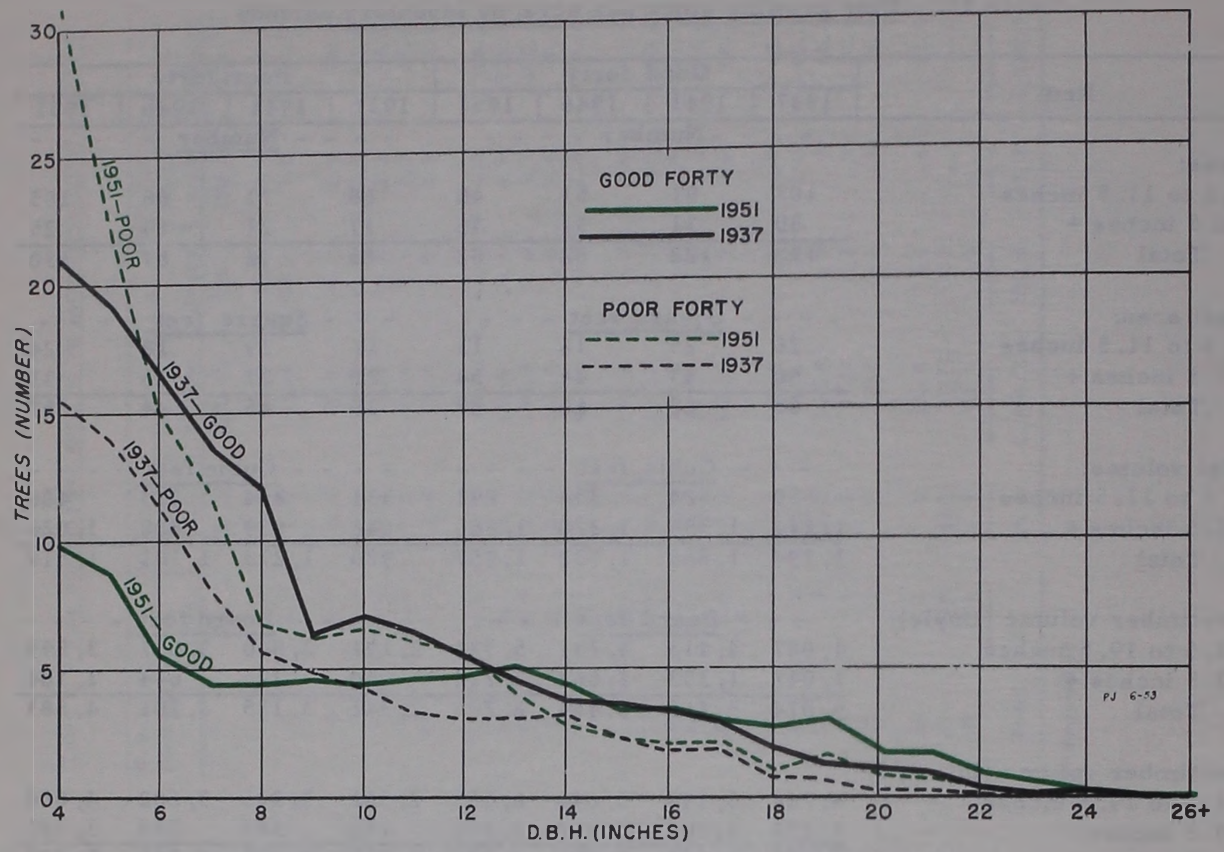

Figure 3.— Number of pine trees per acre, good and poor forties.

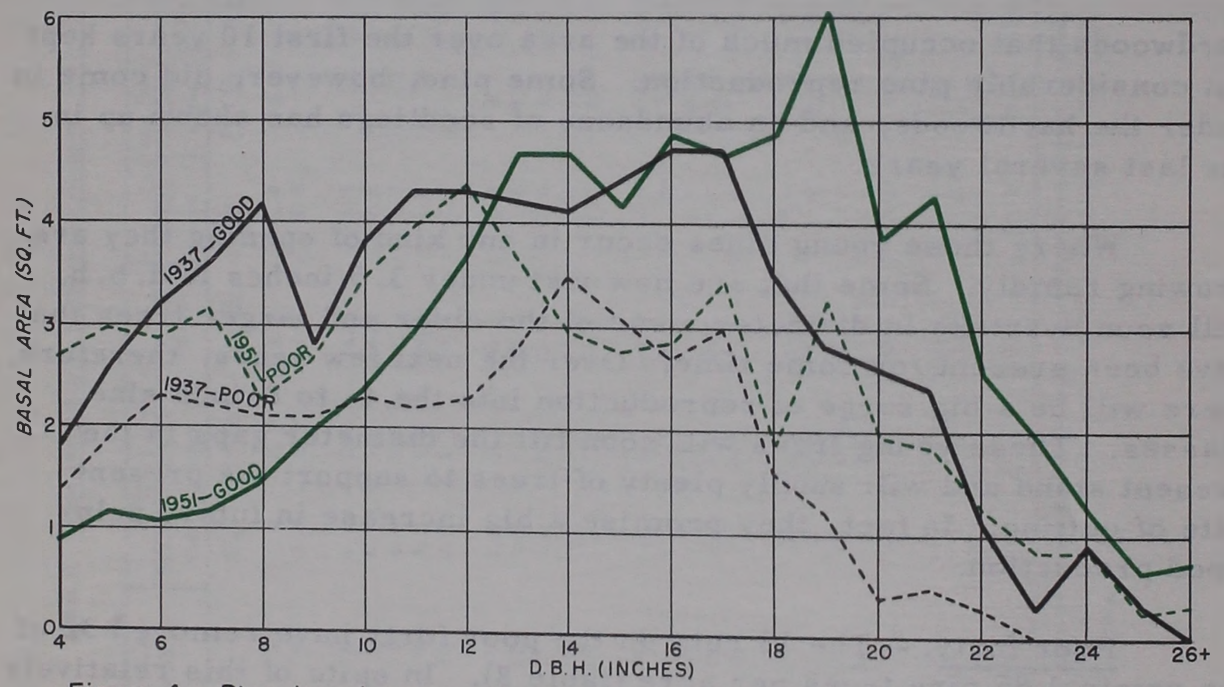

Figure 4.— Pine basal area per acre, good and poor forties.

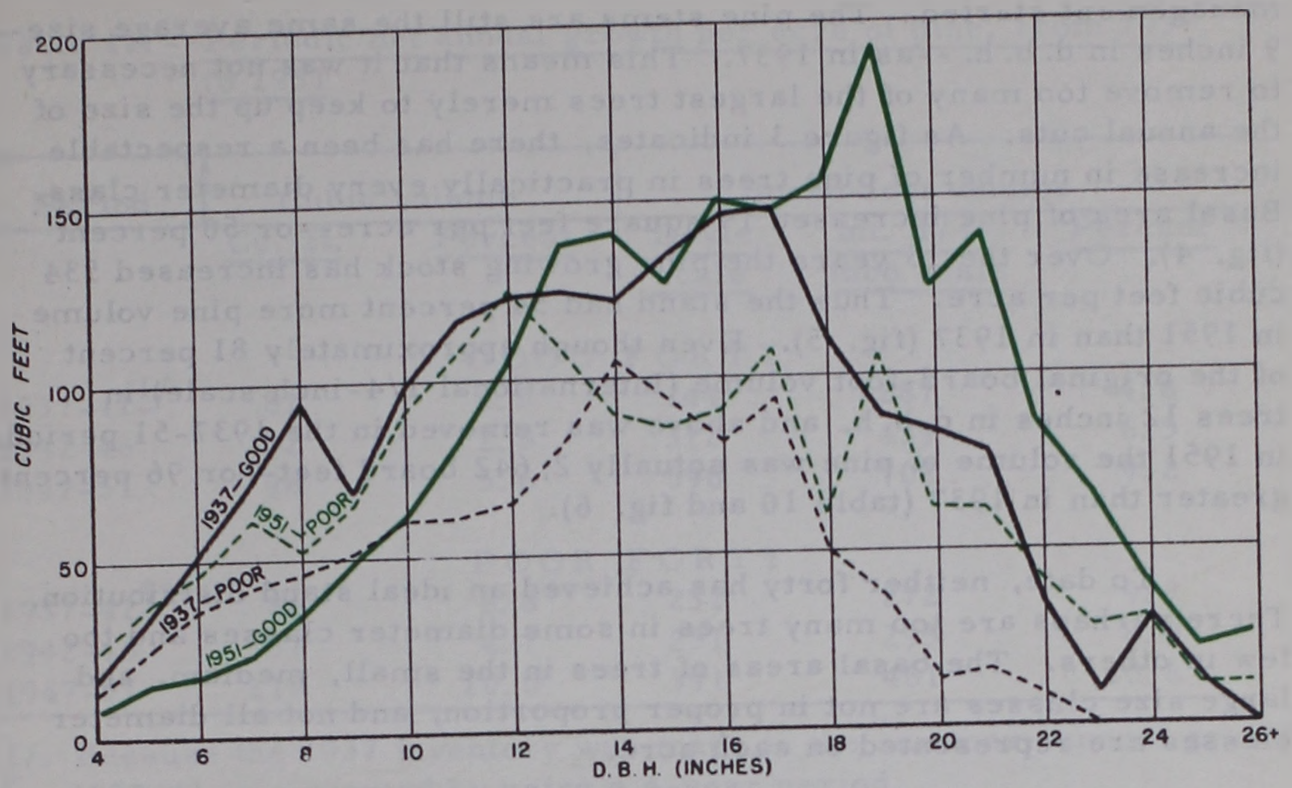

Figure 5.—Pine cubic volume per acre, good and poor forties.

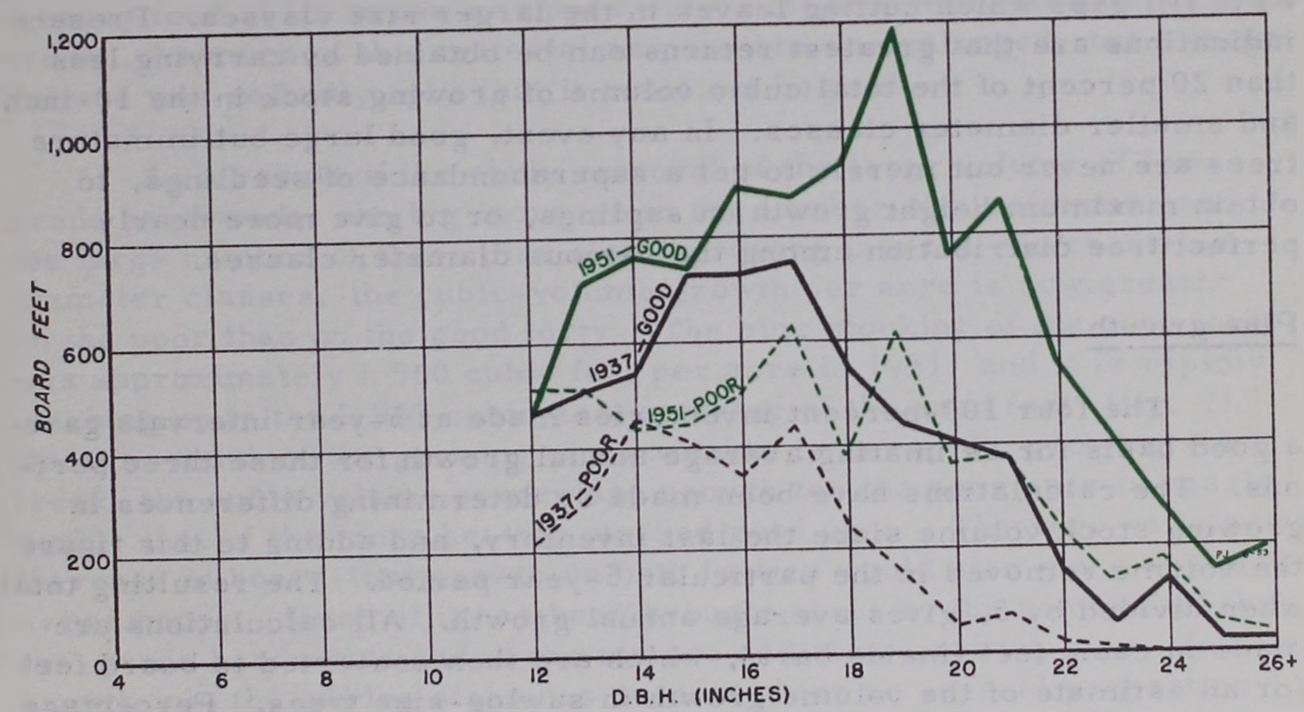

Figure 6.—Pine board-foot volume per acre, good and poor forties.

management started. The pine stems are still the same average size--9 inches in d. b. h. --as in 1937. This means that it was not necessary to remove too many of the largest trees merely to keep up the size of the annual cuts. As figure 3 indicates, there has been a respectable increase in number of pine trees in practically every diameter class. Basal area of pine increased 19 square feet per acre--or 50 percent (fig. 4). Over the 15 years the pine growing stock has increased 534 cubic feet per acre. Thus the stand had 54 percent more pine volume in 1951 than in 1937 (fig. 5). Even though approximately 81 percent of the original board-foot volume (International 1/4-inch scale) in trees 12 inches in d. b. h. and above was removed in the 1937-51 period, in 1951 the volume of pine was actually 2, 642 board feet--or 96 percent--greater than in 1937 (table 10 and fig. 6).

To date, neither forty has achieved an ideal stand distribution. There perhaps are too many trees in some diameter classes and too few in others. The basal areas of trees in the small, medium, and large size classes are not in proper proportion, and not all diameter classes are represented on each acre.

However, since the production of large, high-grade sawlogs is the goal of management, stems in the 12-inch class and below are considered merely as a pool of reserve trees to be drawn on as needed to fill gaps which cutting leaves in the larger size classes. Present indications are that greatest returns can be obtained by carrying less than 20 percent of the total cubic volume of growing stock in the 10-inch and smaller diameter classes. In any event, good large but immature trees are never cut merely to get a superabundance of seedlings, to obtain maximum height growth on saplings, or to give more nearly perfect tree distribution among the various diameter classes.

Pine growth

The four 100-percent inventories made at 5-year intervals gave a good basis for estimating average annual growth for these three periods. The calculations have been made by determining differences in growing stock volume since the last inventory, and adding to this figure the volume removed in the particular 5-year period. The resulting total, when divided by 5, gives average annual growth. All calculations are made in cubic feet (inside bark), which are then converted to board feet for an estimate of the volume growth in sawlog-size trees. Percentage growth is determined by dividing the volume present at the beginning of the period into the yearly growth and multiplying by 100. Thus these values are net periodic annual growth percents (table 11); non-salvageable mortality has been excluded.

Table 11. --Periodic net annual growth per acre of pine, from 1937 to 1951

Period	Cubic volume		Board-foot volume		
	Cu. ft.	Percent	Doyle scale	Int. 1/4-inch scale	Percent
			GOOD FORTY		
1937-41 1/	81	4.5	244	287	4.8
1942-46	52	2.8	372	439	6.5
1947-51	98	5.6	596	702	9.2
			POOR FORTY		
1937-41 1/	86	8.8	231	272	9.8
1942-46	57	4.7	251	295	8.0
1947-51	118	10.0	391	461	10.6

1/. Because the 1937 inventory was made in the summer, annual growth for 1937-41 is computed by using a 4-year period.

The drop in cubic-foot and percentage growth during the 1942-46 period undoubtedly reflects the severe damage suffered in 1944, when a heavy load of ice broke or tipped over a large number of 4-to 9-inch trees. As much of this material as possible was salvaged, but a large volume was so badly split that it could not be used.

As a result of the early removal of the large volume of low-grade hardwoods, the big increase in the number of pine stems, and the large number of these pine stems growing into the merchantable diameter classes, the cubic-volume growth per acre is now greater on the poor than on the good forty. The pine stocking of the poor forty was approximately 1,500 cubic feet per acre in 1951, and it is rapidly catching up to the 1,957 cubic-foot stocking of the good forty (fig. 7). Because much of the growing stock volume is in rapidly growing small trees, the cubic volume percentage growth for the poor area is nearly double that of the more heavily stocked good area. The very satisfactory increase in board-foot growth on both forties would also make any landowner happy. Much of it has been brought about by the removal of the low-grade hardwoods and of the mature and slow-growing pine. Ingrowth into the sawlog sizes has accounted for an unusual proportion of the board-foot growth on the poor forty. The number of fast-growing big trees is responsible for a considerable portion of the very good sawlog growth on the good forty.

Figure 7.--The poor forty after 15 years of management. Small pines have filled nearly all of the openings in the stand, and the forest is now very near to full stocking.

Pine stocking

Since 1937 the trees on the two forties have produced one fair (1942) and two good crops (1939 and 1950) of pine seed. Much of the 1939 crop was lost because a great deal of the area was still occupied by low-grade hardwoods. Removal of many of the hardwood stems during the 1940's saved many of the seedlings of the 1942 crop. The timber stand improvement job in 1951, when all remaining hardwoods 4 inches in d. b. h. and larger were cut or girdled, released many of the suppressed seedlings of the earlier crops and allowed many seedlings from the 1950 crop to become well established. No fire, controlled or natural, has burned any part of either area since before 1933. What part of the total area is now occupied by pine?

A survey of pine stocking was undertaken in the late summer of 1951. Temporary milacre (1/1000-acre) plots were taken at two-chain intervals on lines spaced two chains apart. Each plot was classified as to whether it was overtopped by a pine or hardwood crown (and hence did not need or could not use a pine seedling) or was free of overstory competition. Next, each plot was classified as to whether it contained a pine smaller than 3.5 inches in d. b. h., and whether this pine needed release.

It was found that 91 percent of the milacre plots on the good forty and 93 percent of those on the poor forty were either stocked with small pines or overtopped by large pines (table 12). Such stocking must be considered excellent, for it is rarely exceeded even in the most successful pine plantations.

THE CROSSETT FORTIES AND THE SMALL LANDOWNER

What can the average owner of a small tract of woodland expect from intensive management? There is plenty of room for difference of opinion on the subject, but 15 years of experience with the Crossett forties would seem to have the following significance to the farmer or small woodland owner:

Most owners do not have the good stocking and large trees of the good forty, and consequently very few can expect, for some years to come, returns similar to those from this area. The good forty is primarily indicative of the eventual goal of management. The poor forty, however, does show how the more typical understocked and unmanaged farm woodland can be made to produce. As has been indi-

cated, it has been built up from a run-down to a highly productive forest in 15 years. In 1951 the average stumpage return per acre was over $10.00.

Table 12. --Overtopping conditions, stocking, and need for release of pine, 1951

Stocking	Good forty	Poor forty
	Percent of total area	
Overtopping conditions--trees larger than 3.5 inches in d.b.h.		
Overtopped by pine	59	50
Overtopped by hardwood	2	0
Free of overtopping tree	39	50
Available for pine reproduction	41	50
	100	100
Pine stocking		
Overtopped by pine	59	50
Available area stocked with pine 3.5 inches d.b.h. and smaller	32	43
Overtopped or stocked with pine	91	93
Need for release of pine		
Needing release	4	3
Requiring no release	87	90
Overtopped or stocked with pine	91	93

The owner of the average small woodland does not need a wide knowledge of forestry to obtain returns nearly as good as those from the Crossett forties--provided his stocking is similar. A rudimentary knowledge of how trees grow and occasional help from a forester is all that is required. A forester's help is most likely to be needed when the owner has to determine inventory, growth, and allowable cut; to learn how to select trees for harvest; and to deal with unwanted hardwoods.

Annual cuts have proved thoroughly feasible and very profitable, but are not required. The small landowner may choose to sell his stumpage or make his cuts at longer intervals, although periods longer than 5 years are not recommended. The shorter the period, the easier it is to salvage damaged trees and to anticipate mortality.

The farmer with the necessary equipment can greatly increase his total return and have a profitable off-season job by doing his own logging.

Finally, it is believed that the timber-growing potentialities of the Crossett forties are not much different from those on most small forests in the same region. Since the typical small stand is considerably depleted, the owner will have to reduce his cut below growth for several years and otherwise approximate the measures used at Crossett. If he will do these things, he should be able to get fully 90 percent of the growth obtained on the Crossett forties.

SUMMARY

In 1937 a poorly stocked woodland of 34 acres and a well-stocked area of 40 acres were established on the Crossett Experimental Forest, in southern Arkansas, to determine the possible costs and returns from intensively managed small tracts of timber in the shortleaf-loblolly pine-hardwood type.

In order to create greatest possible interest in the management of farm woodlands, it was decided to determine if it was possible to make annual cuts of products.

Management has been on a modified single-tree selection system. The aim has been to produce a maximum of high-grade sawlogs, plus whatever pulpwood and other products would come from thinnings, tops of sawlog trees, and improvement cuttings.

The annual cuts on the good forty have been approximately equal to the yearly growth. Because of the need for building up the growing stock on the poor forty, annual cuts there have been limited to approximately one-half of the total pine cubic-foot growth each year.

To minimize errors in estimation of growth, a 100-percent inventory system was adopted. Complete reinventories are made every 5 years. The annual allowable cuts are determined from the differences between these inventories.

All cutting during the first 15 years has aimed at removing the poor, limby, defective trees first and saving the best for additional growth.

Since merchantable hardwoods on the poor forty were of very low grade, they were removed during the first seven years of the study. For several years much of the hardwood on the good forty, even though not of good quality, was saved to provide an annual cut of firewood. By the middle 1940's, however, it was apparent that other fuels were replacing wood, and all merchantable hardwoods were cut and sold.

All non-merchantable hardwoods 3.5 inches and larger in diameter were girdled in 1951. Cost of this operation was 2.6 man-hours or $2.08 per acre on the good forty and 2.4 man-hours or $1.92 per acre on the poor forty.

The fourteen annual harvests on the good forty have yielded 174,500 board feet (Doyle scale) of logs, 312 cords of pulpwood, 228 cords of firewood and chemical wood, and 418 white oak fence posts. Thirteen annual cuts on the poor forty have yielded 57,500 board feet (Doyle scale) of logs, 153 cords of pulpwood, 158 cords of firewood and chemical wood, and 121 fence posts.

At stumpage prices that prevailed during the year in which the cutting was done, the fourteen cuts on the good forty produced a total stumpage return of $3,442, or $86 per acre--$6.15 per acre per year. The poor forty yielded $1,671 of stumpage value from the products cut during the 15 years. This is equal to $49.15 per acre, or $3.78 per acre per year.

Taxes, fire protection, timber stand improvement, timber marking, scaling, and supervision have averaged $0.27 per acre per year cash outlay plus one hour per acre annually of the owner's time.

If all products had been sold as stumpage, the net return for labor in growing and handling the crop would have been $5.47 per hour on the good forty and $3.01 on the poor forty.

The good forty produced nearly 8,000 man-hours of labor opportunity for harvesting products and hauling them to the mill or market. The poor forty produced 4,350 man-hours of labor opportunity. Thus, the good forty created an average of nearly 3-1/2 man-months of off-season labor per year and the poor forty nearly 1-1/2 man-months.

With stumpage value and all out-of-pocket costs deducted from the mill value of the products, the return for labor and use of equipment on the good forty over the 15 years has averaged $0.77 per hour. The return from the poor forty has averaged $0.64 per man-hour.

Following is a synopsis of the stocking per acre when management began, amount cut during the 15 years, growth for the same period, and stands present in 1951:

Table 13. --Changes in pine stocking per acre, farm forestry forties, 1937-1951

Item	Good forty				Poor forty			
	Stand in 1937	Cut 1937-1951	Growth 1937-1951	Stand in 1951	Stand in 1937	Cut 1937-1951	Growth 1937-1951	Stand in 1951
Trees over 3.5 in. d.b.h.								
Number	132	52	2	82	85	32	77	130
Basal area (sq. ft.)	66	32	33	67	38	24	43	57
Vol. (cu. ft., i.b.)	1,794	900	1,063	1,957	980	700	1,234	1,514
Trees over 11.5 in. d.b.h.								
Vol. (Doyle)	5,074	2,597	5,818	8,295	2,341	1,866	4,108	4,583
Vol. (Int. 1/4-inch)	5,978	3,059	6,853	9,772	2,757	2,199	4,841	5,399

Growth on the good forty has increased from 244 board feet (Doyle scale) per acre per year during the 1937-41 period to 596 board feet per acre per year during the 1947-51 period. The growth on the poor forty has increased from 231 to 391 board feet per acre annually.

Ninety-one percent of the ground area of the good forty is stocked with overstory pine or pine reproduction; four percent of the area in reproduction needs release from overtopping hardwoods. Ninety-three percent of the poor forty is stocked to pine. Three percent of the stocked area needs release from hardwoods.